

## Research Article



# The Effects of Type of Fitting, Technology and User Experience on Satisfaction with Hearing Aid Assessed by Persian Version of the MarkeTrak Survey

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## Highlights

- Experience and technology did not influence Hearing Aid (HA) satisfaction
- Persian MarkeTrak is valid and reliable for measuring HA satisfaction
- Bilateral HA users are more satisfied with HA use than unilateral HA users

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## ABSTRACT

**Background and Aim:** Satisfaction with hearing aids is very important for continued use of the device and improving hearing status and quality of lives of people with hearing loss. MarkeTrak survey has been used for many years to track factors influencing satisfaction with hearing aids. This study aimed to make a valid and reliable Persian version of the MarkeTrak survey to measure the effects of type of fitting, experience and technology on hearing aid satisfaction.

**Methods:** After confirmation of validity and reliability of the Persian MarkeTrak, 71 people participate in the study. The effects of bilateral versus unilateral hearing aids (type of fitting), experience and wireless versus non-wireless technology were tested.

**Results:** Bilateral hearing aid users has significantly higher satisfaction rate than unilateral users (65.6±7.2 versus 59.9±17.7). The effects of experience with using hearing aids and type of technology did not reach statistical significance.

**Conclusion:** Higher satisfaction with bilateral hearing aids might result from better sound quality in diverse listening conditions, spatial hearing and directionality with two ears rather than one ear.

**Keywords:** Persian MarkeTrak; bilateral hearing aids; wireless; experience; satisfaction



## Introduction

**H**earing system receives and conducts sound signals through outer and middle ears and these signals are transduced from mechanical form to electrical codes by the inner ear and these electrical codes are interpreted by the central auditory system and auditory cortex as sounds. Damages to outer and middle ears are referred to as conductive hearing loss which is usually cured with surgical intervention or medication [1, 2]. Damages to the inner ear and auditory neural pathway are referred to as Sensorineural Hearing Losses (SNHL). Most of time, SNHL cannot be treated by surgical and medication and Hearing Aids (HAs) or other hearing assistive devices are prescribed and fitted to improve hearing for people suffering SNHL.

HAs have three major parts: a microphone which receives sounds and converts them to electrical form and an amplifier which amplifies and processes sounds according to each person's hearing loss status and needs. The third part is a receiver whose role is to convert the processed sounds into the acoustic form and deliver them to the ear [3].

However, people with SNHL have wide variety of hearing needs. There have been constant efforts by HAs manufacturers and scientists to answer those needs. The success of the efforts can show itself in the satisfaction with using HAs. Being satisfied with using HAs is very important since satisfied HAs customers use them more and for longer hours. These positive effects are very important in reducing negative effects of SNHL on the people suffering it if they remain untreated [4, 5]. For example, people with untreated SNHL would be reluctant to enter a discussion and this could lead to social loneliness and depression especially in elderly people. Antisocial behaviors, aggression and low self-esteem are other reported consequences of untreated SNHL [6-10]. These negative consequences of SNHL are very important that 750 billion dollars is spent annually to treat or reduce the consequences of hearing losses worldwide [11]. Therefore, factors influencing satisfaction should be identified. However, it is very necessary to measure these factors with proper and precise instruments.

In general, satisfaction with using HAs is measured with valid and reliable questionnaires and surveys [2]. It has been reported that size, shape, appearance, and services after purchase have influential impacts on satisfaction rate with Has [5, 9]. Also, there were people who have not been satisfied with HAs for reasons such

as whistling, visibility of HAs, poor hearing in noisy environments and expenses. Therefore, a suitable questionnaire should pay attention to all psychological, financial and technological factors affecting satisfaction with using Has [8, 12].

The most comprehensive HAs survey used for satisfaction in the USA is the MarkeTrak which was developed in 1989 [6]. The MarkeTrak has gathered the largest dataset in the world. The latest version of MarkeTrak has three parts. The first part deals with product specifications in which comfortable fitting, safe usage, effectiveness for communication in noisy environment and battery life time. The second part is about using HAs in different environments (listening to sounds in one-to-one quiet or a small groups or restaurants, in cars and similar situations). The third part is about services delivered to patients by hearing healthcare practitioners and their knowledge to address patients' problems. Each question in the survey comes with a Likert response format from very dissatisfied to very satisfied. The results of this survey is expressed in percentage [8-10].

Previous research has shown that bilateral amplification (using HAs for both ears) might influence satisfaction of hearing loss [13]. Another change is that analog HAs are not manufactured anymore and nearly all currently used HAs are benefiting from non-wireless and wireless technology [14]. Previous studies showed that people with digital HAs had higher satisfaction than those with analog Has [14, 15]. However, there are not any published studies to compare the satisfaction with using non-wireless versus wireless HAs. This comparison is worth studying more. Some studies claimed that people who have received HAs recently had lower satisfaction than those with longer experience [16, 17]. The reason for this finding might be unrealistic expectations in new users from HAs. These expectations might become more realistic over time.

Since the MarkeTrak survey has gathered a lot of information about trends in Has [8, 18], the Persian version of the MarkeTrak can be used to gather information about factors affecting HAs satisfaction among Iranian users and this information can be compared with data from the USA and other countries to investigate the similarities and differences between users of different countries [18]. Therefore, this study aimed to assess the effects of type of fitting (unilateral versus bilateral HAs), technology (non-wireless versus wireless HAs) and experience with HAs (new users versus experienced users) on satisfaction with HAs after the assessment of validity and reliability of the Persian version of the MarkeTrak survey.

In the first phase of the study, the validity and reliability of the Persian MarkeTrak were determined then the second phase, the effects of aforementioned factors were assessed.

## Methods

Validity determines the relevance of measurement to the construct which an instrument aims to assess [7]. Reliability deals with the stability of the results with an instrument over a given period of time provided that the condition and method of the assessment remain unchanged [7].

In this study, 82 participants signed the consent participation forms and filled the Persian version of the survey for the first time. This study was conducted according to the principles of Helsinki ethic codes for human research. However, since 11 people did not fill the survey for the second time, their information was removed from the study. Therefore, the data for 71 people who filled the survey in both time intervals were analyzed. Their demographic information was gathered and other information like the onset of hearing loss, the time of receiving and type of HAs was recorded. There were 40 females with mean age of 62 years and standard deviation of 4.9 years (ranged from 52 to 84) and 31 males with average age of 65 years with standard deviation of 6.6 years (ranged from 36 to 79). They all had symmetrical bilateral hearing loss with severity from mild to severe. 16 people had flat hearing losses while 55 people had sloping sensorineural hearing losses.

The translation and standardization of the Persian version of the MarkeTrak were administered according to the international quality of life assessment guideline [8]. The 6 translators (for forward and backward translations and judges for disagreement among translators over some items) were selected from the audiologists who were experts in both English language and audiology in general and HAs in specific.

In fact, validity assesses the accuracy of measurement and the presence or absence of systematic errors in the construct under measurement [7]. The face validity of the Persian version of MarkeTrak survey was determined by asking questions from HAs users about clarity, simplicity and understandability characteristics of the items. For content validity, 6 experts (academic audiologists) answered the questions about the Persian version of the MarkeTrak using a Likert scale in a range from not clear, not simple and not understandable to

completely clear, simple and understandable. Both face and content validities were assessed qualitatively.

Reliability showed that whether the Persian version of the MarkeTrak was assessing the concept which was supposed to measure (i.e. the concept of satisfaction with using HAs). The reliability of the Persian version was measured from two perspectives: internal consistency between items and stability. Internal consistency between items revealed itself in Cronbach's alpha. The scores could vary from 0 to 1 which scores 0.7 or above indicated acceptable level of internal consistency [7]. Also, inter-item correlations showed the amount of association among six aspects of satisfaction with using HAs present in MarkeTrak survey (product specification, quality of sound and sound signal processing, listening conditions, service delivery professional, usage, application and behavior).

Stability was tested with test-retest methods between of the results taken from HAs users in two time intervals. The interval between the two tests was one month which was reported a suitable interval in the previous research [9]. The Appendix 1 shows the Persian version of MarkTrak survey.

After the determination of validity and reliability, three possible factors influencing satisfaction using HAs were tested. These three factors were HAs type of fitting, technology and experience with HAs. Comparing the scores of 48 people with unilateral HAs versus those of 23 people with bilateral HAs showed the effect of HAs type of fitting. To test the effect of technology on satisfaction with HAs, the scores of 40 people using non-wireless HAs were compared with those of 31 people wireless HAs. In terms of experience, 46 people were categorized as new users and 25 people as experienced users. The hypothesis was people using bilateral HAs, wireless technology and with more experience with HAs would have significantly higher rate of satisfaction than people with unilateral HAs, digital technology and with no experience respectively. All the procedures were done according to the Iran University Ethic Principles for research.

## Results

In the translation part of the study, the translators number 1 and 2 were in agreement except for items 3, 12, 14, 29 and 44. After discussion between them, they reached an agreement on selecting terms for these items. The final version was scored by the translators' number 3 and 4. Scores above 90 percent were considered as the high

**Table 1.** Inter-correlation between different parts of the survey

Inter-item correlation	Product features	Sound quality/signal processing	Listening situations	Dispenser	Usage	Behavioral
Product features	-	0.67	0.71	0.68	0.84	0.79
Sound quality/signal processing	0.67	-	0.66	0.61	0.69	0.61
Listening situations	0.71	0.66	-	0.72	0.76	0.72
Dispenser	0.68	0.61	0.72	-	0.75	0.64
Usage	0.84	0.69	0.76	0.75	-	0.86
Behavioral	0.79	0.61	0.72	0.64	0.86	-

quality for the Persian version and above 80 to 90 percent as good and below 80 as poor qualities. All the items were scored as 90 or above except items 3, 14 and 18 which had scores between 80 to 90 percent. These three items consisted 6 percent out of total items. Therefore, the content validity was confirmed. In the face validity, all items except for items 12, 14, 22 and 29 received the highest percent. These four items also had scores above 80 percent on face validity. Therefore, the face validity was also confirmed for the Persian MarkeTrak survey.

All data gathered from the HAs users were entered into SPSS statistical software package version 17. Cronbach's alpha was calculated for all items to show the general validity of the translated version and it was 0.9. The inter-section Cronbach's alpha was also high (0.9). It indicated that the all items in the translated version of the MarkeTrak survey had strong relationship with each other and all were assessing the construct of satisfaction with HAs use. All the items and the sections of the Persian version had acceptable inter-item correlation indicating they were measuring the same construct (Table 1).

To test reliability, Pearson correlation showed that there was strong correlation between the scores in the two-time intervals ( $r=0.9$ ,  $p<0.002$ ) and three comparisons. In the first comparison, the satisfaction with HAs use was compared between the unilateral and bilateral users of HAs. Table 2 shows the mean of scores in per-

cent for the two groups. An independent t-test was used for statistical analysis.

The statistical analysis revealed that there was a significant difference in the satisfaction rate between the two groups ( $p<0.018$ ). People who used bilateral HAs had higher satisfaction rate (65.5%) compared to those with unilateral HAs (55%). P value was 0.017 for this analysis.

In the second comparison, the satisfaction with HAs use was compared between the HAs users of non-wireless and wireless technologies. The mean, standard deviation and the number of people in each group are shown in Table 2.

Statistical analysis with independent t-test showed there was no significant difference in the satisfaction rate of the two groups ( $p=0.77$ ). The mean for the two groups was also very close to each other (mean for people with non-wireless HAs was 59% and mean for people with wireless HAs was 58%).

In the third comparison, the satisfaction with HAs use was compared between experienced and new HAs users. The mean, standard deviation and the number of people in each group are shown in Table 2.

Independent t-test revealed no significance between the satisfaction rate of experienced and new HAs users

**Table 2.** Descriptive analysis for satisfaction rates for different variables in percentage

	Bilateral	Unilateral	Non-wireless	Wireless	New	Experienced
Mean	65.6	55.9	59.7	58.1	61.3	54.8
SD	7.2	17.7	13.2	18.7	14.7	17
Number	23	43	40	31	46	25

( $p < 0.07$ ) although it was very close to significance level. The mean of satisfaction with HAs use for the new users was 61% compared to 54% for the experienced users.

## Discussion

English MarkeTrak has collected the largest data set from 1989 periodically [1, 8-10, 19, 20]. This study aimed to make a validated and reliable Persian MarkeTrak survey. This translated version was made compatible with Iranian culture and was of face validity. Most of the items in the translated version received high scores from professionals. This might be due to the fact that the concepts in the English version were simple and were expressed as one-word phrase or were categorized under highly related topics and there were enough clear for the Iranian people. This indicates that all the items and subcategories were trying to assess the same construct in Persian version of the survey (i.e. satisfaction with using HAs). Another finding of this study was high correlation coefficient between test-retest results for the Persian MarkeTrak which showed enough stability in measurement.

In the first comparison, the bilateral users were 10 percent on average more satisfied with using HAs than unilateral users. In addition, the standard deviation of the bilateral users was also lower which means less variation among the bilateral users than the unilateral users despite the fact there were fewer people in the bilateral user group. This finding showed that the satisfaction with using bilateral HAs was higher among Iranian HAs users as well as other countries [16, 19]. This might result from better sound quality in diverse listening conditions (e.g. quiet noisy and reverberant conditions), spatial hearing and directionality with two ears rather than one ear. Using two ears and receiving hearing inputs overcome hearing shadow occurred with hearing with one ear. Hearing shadow means when sounds coming to ears from the side which is not fitted with HAs (in unilateral HAs use), they may not be heard enough well. Bilateral fitting may solve this problem and result in better directionality and speech-in-noise perception.

However, there was one difference between the result of this study with that of English MarkeTrak survey conducted over a couple of ten thousand HAs users in the USA. While there were only 33% of the participants of this study who used bilateral fitting, 74% of HAs users in the USA used bilateral fitting. This can be understandable as the health insurance policies and marketing factors like the access to modern hearing aids and assistive listening technologies in public are different in two countries.

It was shown advanced technology has had positive effects on the satisfaction with using HAs [15] for example using non-wireless HAs versus analog HAs [3, 7, 19]. It might be expected that wireless technology in HAs industry could lead to higher satisfaction rate compared to non-wireless HAs. In this study, the difference between two groups did not reach significance level statistically. This might be due to fact the essence of both non-wireless and wireless HAs is the same. They both are digital. Therefore, this similarity has led to similar benefits from sound processing schemes. These processing schemes are able to be performed with both non-wireless and wireless technologies. Another reason might be that wireless technologies can only outperform non-wireless HAs when people use bilateral HAs while in the current study, almost half of the participants used unilateral HAs. In addition, Picou's study has shown that the rate of using wireless HAs has increased in recent years [21] and it means that the satisfaction rate with non-wireless and wireless HAs users worth studying.

Previous studies reported that people with more experience with HAs had higher satisfaction compared with new users [3, 5]. In addition, there were some studies reported no significant difference between experience and satisfaction with HAs as well. It was difficult to set a cutoff for categorization of people into "experienced" and "new users". In this study, if a participant was using his or her first HAs, they were categorized as the new users. Otherwise, they were put in experienced group. There was not any significant difference between the two group in this study in term of satisfaction rate. There were more people in the new experienced group and people who were using second HAs, might be dissatisfied with their previous HAs and this dissatisfaction might be related to their previous experiences with HAs and not their current HAs. This should be considered in the future study of satisfaction with HAs. Another suggestion is that using use hours per day might be a better factor for categorization of people into new and experienced groups.

## Conclusion

The clarity, understandability and magnitude of available data gathered with the MarkeTrak survey in a long-term period, make this survey an excellent instrument in the assessment of satisfaction with HAs. The Persian MarkeTrak had enough reliability and validity in the assessment of satisfaction with HAs use. With this Persian version, it is now possible to investigate factors influencing satisfaction with HAs use among Iranian people and compare data with the data from the USA considering the fact that the English version gathers data from a large number of people and the Persian version is limited in

this regard. For better comparison, this study might be better administered at national level on large number of HA users as a next step for this research. This survey can be used in future studies to determine the effects of other factors like new coming technologies and demographic factors on satisfaction with HAs.

## Ethical Considerations

### Funding

No funding was received for this study.

### Authors' contributions

SM: Study design, acquisition of data, and drafting the manuscript; MK: Study design and supervision, interpretation of the results, and critical revision of the manuscript; MM: Interpretation of the results and critical revision of the manuscript; HM: Design of the experiment, revision the manuscript.

### Conflict of interest

There are no conflicts of interest, financial, or otherwise.

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